BY ORDER OF THE COMMANDER
TRAVIS AIR FORCE BASE

TRAVIS AIR FORCE BASE
INSTRUCTION 48-102

20 MAY 2002

Aerospace Medicine

PREVENTION OF HEAT STRESS DISORDERS

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

NOTICE: This publication is available digitally on the AFDPO WWW site at: **http://www.e-publishing.af.mil.**

OPR: 60 AMDS/SGPB
(TSgt Anthony F. Llanes)
Supersedes TAFBI 48-102, 5 June 1997

Certified by: 60 AMDS/SGPB
(Lt Col Mark G. Tiedemann)
Pages: 11
Distribution: F

This instruction implements AFPD 48-1, *Aerospace Medical Program*. It establishes Travis AFB responsibilities and procedures to prevent adverse effects of heat stress. This instruction establishes policies and rules for all personnel who are assigned to Travis AFB and perform non-flying (ground) operations and duties during periods of hot weather. It does not apply to contractor personnel. It defines the Wet Bulb Globe Temperature (WBGT) Index, WBGT monitoring and reporting procedures, Heat Stress Index, Heat Stress posting, and unusual clothing stipulations. During mission essential, contingency or emergency operations, commanders may waive the provisions of this instruction; however, when commanders waive procedures they must ensure all supervisors exercise caution, make certain all subordinate personnel are aware of heat injury symptoms and take actions to protect the health of their personnel. (***NOTE*:** See **Attachment 1**, Glossary of References and Supporting Information, associated with this instruction.)

SUMMARY OF REVISIONS

During hot weather when temperatures reach **92°F (Change from 77°F)**, 60 AMDS Bioenvironmental Engineering Flight (BEF) (60 AMDS/SGPB) will routinely monitor WBGT readings and initiate Heat Stress Advisories. Deleted the Main Gym (60 SVS/SVMP) as one of the high profile areas on Travis AFB that will procure and display appropriate Heat Stress Condition in accordance with (IAW) this instruction.

1. Mandatory, Preferred And Acceptable Requirements:

1.1. May. Indicates an acceptable or satisfactory method of accomplishment.

1.2. Should. Indicates a preferred method of accomplishment.

1.3. Will. Indicates a mandatory requirement and is also used to express a declaration of intent, probability or determination.

2. Responsibilities:

2.1. 60 AMDS Bioenvironmental Engineering Flight (BEF) (60 AMDS/SGPB).

2.1.1. Will manage the Heat Stress Program.

2.1.2. Will measure and monitor Wet Bulb Globe Temperature (WBGT) Index IAW Paragraphs **3.3.** and **3.4.** Upon request, during non-routine activities (change of command ceremonies, parades, chemical warfare exercises) BEF will monitor localized WBGT at the site of non-routine activities. The WGBT Index is synonymous with Heat Stress Index.

2.1.3. Each time the Heat Stress Index changes, BEF will provide notification IAW Paragraph **3.4.4.** Issue a Heat Stress Advisory IAW Paragraph **3.4.5.**

2.1.4. During normal duty hours, all related questions/concerns will be directed to BEF. After duty hours, emergency items will be directed to BEF technician on-call via the David Grant Medical Center (DGMC) Emergency Room (ER).

2.2. 60 AMW Command Post (60 AMW/CP), once informed by BEF, will notify wing, group and tenant unit commanders' offices:

2.2.1. 15 AF/CC

2.2.2. 60 AMW/CC

2.2.3. 60 LG/CC

2.2.4. 60 MDG/CC

2.2.5. 60 OG/CC

2.2.6. 60 SPTG/CC

2.2.7. 349 AMW/WCC (Wing Control Center)

2.2.8. 615 AMOG/CC

2.2.9. Base Operations

2.2.10. OL-E AFCESA/CEMIRT

2.2.11. VQ-3 DET

2.2.12. 388 FW Det 1

2.3. Organizational commanders are responsible for disseminating the Heat Stress Advisory throughout their respective organization.

2.4. First line supervisors and workers in non-flying activities are to be notified of conditions. They are to ensure that all their personnel are briefed on the contents of this directive and take appropriate precautions, (See Paragraphs **3.5.** and **5.** for guidelines to exposure and precautions, respectively).

2.5. Individuals must report suspected heat stress disorders to their immediate supervisor and take protective measures to prevent adverse heat effects reference Paragraph **5.**

3. Procedures:

3.1. When notified of any of the heat stress conditions listed in Table 3.4.5, Command Post will immediately disseminate a Heat Stress Advisory to those listed in Paragraph **2.2.** Personnel operating

outside the heat stress recommended activity restrictions may only do so at the direction of the Wing Commander or his/her representative. Heat Stress Conditions remain unchanged. When notified, Base Operations will activate the Secondary Crash to pass Heat Stress Conditions to the agencies on the Secondary Crash Net.

3.2. Heat Stress Posting: Heat Stress Condition posting may be accomplished by hoisting a flag or erecting a stand with the appropriate symbol.

3.2.1. The following organizations will post the appropriate Heat Stress Condition (See **Attachment 3**) in accordance with **Table 1.** upon notification of the Heat Stress Weather Advisory.

3.2.1.1. Fitness Center (60 SVS/SVMP: Building 434).

3.2.1.2. Travis AFB Gates (60 SPS/SPOL: Main, Hospital, North, South, and Forbes).

3.2.1.3. Golf Course (60 SVS/SVBG: Building 2012).

3.2.1.4. Logistics Expediter Vehicles (60 LG/SE).

3.2.2. If an organization is open after duty hours and/or weekends, they will check the Heat Stress Advisory hourly via the Heat Stress Hot Line in Building 791.

3.3. Measurement of WBGT Index (Heat Stress Index):

3.3.1. Provider of the WBGT Index will measure the WBGT Index using either the field apparatus described in the ACGIH TLV booklet, the portable hand-held WBGT kit (NSN 6665-00-159-2218) or a suitable commercially available instrument.

3.3.2. In the absence of automated commercially available instrument, formulas from the latest edition of the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) and Biological Exposure Indices will be used to calculate the WBGT Index. These formulas are:

Outdoors with solar load: WBGT = 0.7 NWB + 0.2 GT + 0.1 DB

Indoors or Outdoors with no solar load: WBGT = 0.7 NWB + 0.3 GT

Where: DB = Dry-Bulb Temperature; GT = Globe Temperature; NWB = Natural Wet-Bulb Temperature.

3.3.3. An entry will be made on a daily log sheet indicating: Date, time of readings, WBGT or NWB, GT and DB, the initials of the person performing the monitoring, and initials of individuals and name of organizations contacted.

3.3.4. BEF will maintain logs for one year.

3.4. Monitoring of WBGT and Notification of Heat Stress Index:

3.4.1. When predicted or forecasted outside temperatures reach 92^{o}F or more as a daily high, the WBGT will be checked by BEF at least four times, evenly spaced, during the hottest part of the day. Example measurement times might be at the hours of 1000, 1200, 1400 and 1600 or 0900, 1100, 1300 and 1500.

3.4.2. When the Heat Stress Index reaches and while remains at or above 92° F, the WBGT will be monitored at least hourly. Due to minimal heavy workloads after 1800 hours, the WBGT monitoring will cease at that time unless the Heat Stress Index is greater than or equal to 85°F.

3.4.3. Heat Stress Advisories will be disseminated every time the Heat Stress Index changes IAW **Table 1.** If the Heat Stress Index increases more than one Heat Stress Condition (e.g., from 82° to 88° F), a second reading will be taken after five minutes to confirm the reading. If confirmed, appropriate notifications will be made. If the reading was in error, a third reading will be taken five minutes later to verify Heat Stress Condition. In order to downgrade a Heat Stress Condition, the verification procedure for increasing more than one Heat Stress Condition will be followed.

Table 1. Heat Stress (WBGT) Index, Condition (Symbol) and Recommended Activity Restrictions

HEAT STRESS INDEX (° F) (or WBGT INDEX)	HEAT STRESS CONDITION (SYMBOL)	RECOMMENDED ACTIVITY RESTRICTIONS
77 - 84.9	Green Zone (Green Stripe Symbol)	Follow guidance in **Attachment 2**
85 - 87.9	Caution Zone (Yellow Stripe Symbol)	UNACCLIMATIZED: Individuals should be aware of heat stress and exercise caution when performing extreme physical activity
88 - 89.9	Warning Zone (Red Stripe Symbol)	Reduce all outside exercise or heavy activities. UNACCLIMATIZED: Individuals should exercise extreme caution. ACCLIMATIZED: Individuals should limit outdoor activity to a maximum of 6 hours per day
90 and higher	Danger Zone (Black Stripe Symbol)	Limit outdoor activity to mission essential duties. Supervisors take appropriate measure to minimize any individual's exposure to prolonged heat stress.

NOTE: See **Attachment 3** for symbol example

3.4.4. The organization monitoring the WBGT will notify the Command Post and Weather.

3.4.5. Heat Stress Hot Line: The WBGT monitor will update an answering machine which will be a dedicated phone line that base personnel can call to receive the most current Heat Stress Advisory. This message will say:

"Heat Stress Advisory. IAW TAFBI 48-102, the current Heat Stress Index for (day, month) is (__._) degrees F. This is within the _____ zone. This information is updated at least hourly. During duty hours, direct any questions to Bioenvironmental Engineering Flight. After hours, contact Bioenvironmental Engineering Flight technician on-call via the DGMC Emergency Room."

3.5. Guidelines for Occupational Heat Exposures:

3.5.1. Personnel who routinely perform their jobs while exposed to hot environments (such as aircraft maintenance, ground maintenance, and repair work in steam pits and tunnels) are occupationally exposed.

3.5.2. Supervisors of occupationally exposed personnel should use **Attachment 2** to plan work and rest cycles for individuals under their control. When the WBGT Index reaches the temperatures shown in the attachment for the category of workload, supervisors should initiate the work rest regimen.

3.5.3. Exposures above 90^{o} F WBGT should be allowed only when performing mission essential duties and only then with caution.

3.5.4. When necessary to accomplish a task, two or more details should be arranged to work in sequence to ensure each crew receives the proper work and rest cycle.

3.5.5. Failure to comply with the recommended work and rest cycles may result in a notice of violation under the general duty clause, Section 5a(1) of the *Occupational Safety and Health Act of 1970.*

4. Heavy, Restrictive Clothing:

4.1. Wear of overly bulky and restrictive clothing (e.g., chemical warfare defense ground crew ensemble: CWDE) places an added heat stress burden on individuals. If personnel are wearing CWDE or other heavy, restrictive clothing, a correction factor must be added to reported Heat Stress (WBGT) Index to account for added physiological stress. See **Attachment 2** for guidance.

5. Supervisor/Individual Considerations:

5.1. Ability to adjust and tolerate heat varies with the individual. Some of these factors are:

5.1.1. Acclimatization (body's ability to adjust to heat).

5.1.2. Duration of exposure.

5.1.3. Amount of work to be performed.

5.1.4. Air movement and humidity.

5.1.5. Type of clothing worn.

5.1.6. Physical fitness.

5.2. Recognition of Heat Stress Disorders. When one or more of the following symptoms occur, an evaluation by a physician should be sought.

5.2.1. Impaired mental function.

5.2.2. Increased sweating or complete absence of sweating.

5.2.3. Increase in pulse rate.

5.2.4. Weakness, dizziness, or headaches.

5.2.5. Faintness or unconsciousness.

5.2.6. Muscular cramping or convulsions.

5.3. Prevention of Heat Stress Illness or Injury:

5.3.1. Acclimatization - This is of utmost importance for new arrivals from cooler climates. This process takes seven to fourteen days and is directly related to the heat stress imposed on the individual.

5.3.2. Encourage Water Intake. Supervisors are responsible for ensuring water is available. Water must be available within a maximum of 200 feet of a primary work area. Do not use thirst as an index of how much to drink; drink more than you think you might need. Small amounts of water (one pint every hour) are encouraged during periods of moderate activity when exposed to hot temperatures. Milk and coffee do not make up for water loss. Carbonated beverages, while containing water, are not effective in keeping the body hydrated. Electrolyte solutions are highly recommended whether commercial (Gatorade™) or home made.

5.3.3. Obtain adequate rest before physical exertion.

5.3.4. Avoid strenuous exercise during hottest hours.

5.3.5. Wear loose clothing to permit the passage of air.

5.3.6. When possible, schedule heavy work during the cooler early or late hours of the day. More frequent rest periods may be necessary.

5.3.7. Proper Diet - Eat healthy food before starting the day. Donuts and coffee are not adequate. Small amounts of supplemental salt can be beneficial. American diets are usually very high in sodium so large intakes of salt are unnecessary.

JEFFREY N. LEKNES, Lt Col, USAF
Director of Wing Staff

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFPD 48-1, *Aerospace Medical Program*

Threshold Limit Values (TLVs) For Chemical Substance and Physical Agents and Biological Exposure Indices (BEIs), American Conference of Governmental Industrial Hygienists (ACGIH) (1998)

AFI 32-4001, *Disaster Preparedness Planning and Operations (1 May 1998)*

Terms

Acclimatization—A period of adjustment an individual's body requires to become accustomed to working in hot environments. Full acclimatization occurs through progressive degrees of heat exposure and physical exertion. Personnel may need two weeks of increasing exposure to become substantially acclimated and may retain most of their adaptation for about one-week after leaving a hot climate. Workers in good physical condition acclimatize more quickly.

Curtailment vs Suspension of Activities—Curtailment means reducing the level of exertion, reducing the pace of activity and increasing the number and length of the rest periods. Suspension means to stop all strenuous activities temporarily until favorable environmental conditions return.

Heat Stress—Heat stress is the combination of environmental and physical work factors that constitute the total heat load imposed on the body. The environmental heat stress factors are air temperature, radiant heat exchange (example, sunlight), air movement, and relative humidity. Physical work contributes to total heat stress through the body's production of heat (metabolic heat) as it burns energy to sustain the work. This production of metabolic heat depends on the intensity of the physical effort, which is affected, in turn, by body size, muscular developments, physical fitness, and age.

Heat Stress Disorders—Heat stress disorders or heat disorders are general terms used to indicate any type of adverse health problem related to heat. Heat syncope, cramps, exhaustion, and strokes are all forms of heat stress disorders. Heat disorders may be recognize by one or more of the following symptoms: nausea, vomiting, fever, dizziness, headache, faintness, abnormal sweating, convulsion, lack of coordination, mental confusion, and abdominal or leg cramps. The personnel most likely to be affected by the heat are those who are obese, in poor condition, or have just arrived from cooler regions of the country. Heat stress disorders are expressed as:

Heat Syncope—Fainting while standing erect and immobile in heat. Caused by pooling of the blood in dilated vessels in the lower parts of the body.

Heat Cramps—Painful intermittent spasms of the muscles used during work (arms, legs, or abdominal) may occur during or after work hours. Cramps may result from exposure to high temperature for a relatively long time, particularly if accompanied by hard physical work. Cramps usually occur in unacclimated personnel after heavy sweating and are the result of excessive loss of salt from the body. Even if the moisture is replaced by drinking water, the loss of salt by sweating may provoke heat cramps.

Heat Exhaustion—The signs of heat exhaustion of profuse sweating, weakness, rapid pulse, dizziness, nausea, and headache. The skin is cool and sometimes pale and clammy with sweat; however, the body temperature is normal or below normal. Heat exhaustion is caused by a deficiency of water and/or salt

intake and circulatory strain from competing demands for blood flow to the skin and to active muscles.

Heatstroke—Heat stroke is a medical emergency and is caused by exposure to a hot environment in which the body is unable to cool itself sufficiently. This results in the body temperature rising rapidly. The skin is hot, dry, and flushed. Increased body temp, if uncontrolled may lead to delirium, convulsions, coma, and even death. Heatstroke is a much more serious condition than either heat cramps or heat exhaustion.

Wet Bulb Globe Temperature (WBGT) Index—The WBGT Index is a combination of temperature measurements which consider dry air temperature, relative humidity, and radiant heating. The equation for the WBGT Index uses dry bulb (DB) temperatures, natural wet bulb (NWB) temperatures, and globe (GT) temperatures. Heat Stress Index is synonymous with WBGT Index.

Attachment 2

GUIDELINES FOR OCCUPATIONAL HEAT EXPOSURES

A2.1. Permissible Heat Exposure Limits. Limits are defined as the maximum value to which work/rest cycles for each workload should be applied. **Table A2.1.** is extracted from the ACGIH TLV booklet: Work and Rest Cycles for Occupational Heat Exposures. Limits in **Table A2.1.** are based on the following assumptions:

A2.1.1. Personnel are assumed to be acclimated, fully clothed, with average water and salt intake.

A2.1.2. Personnel can take breaks to prevent becoming overheated.

A2.1.3. Exposure limits are based on personnel working in normal work clothing.

Table A2.1. Permissible Heat Exposure Limits (Values given in ^{o}F WBGT)

Work Load (see below)			
Work and Rest Regimen (per hour)	**Light Work Load**	**Moderate Work Load**	**Heavy Work Load**
Continuous Work	86	80	77
75% Work / 25% Rest	87	82	78
50% Work / 50% Rest	89	85	82
25% Work / 75% Rest	90	88	86

A2.1.4. Light work is activity up to 200 Kcal/hr. Example: sitting or standing to control machines, performing light arm or handwork.

A2.1.5. Moderate work is activity 200 - 350 Kcal/hr. Example: walking about with moderate lifting and pushing.

A2.1.6. Heavy work is activity 350 - 500 Kcal/hr. Example: pick and shovel work.

A2.1.7. Calorie (c): the amount of energy needed to raise 1 g of water 1 ^{o}C.

A2.1.8. Example: The current Heat Stress Index is 82.1^{o}F. IAW **Table A2.1.**, if workers are performing moderate work, they should be under 50% Work/50% Rest cycle per hour. If the Heat Stress Index were to drop to 82.0 ^{o}F, the same workers would adhere to a 75% Work/25% Rest cycle per hour.

A2.2. Exposure Limit Variations Due to Clothing. Some of the information in **Table A2.2.** is also excerpted from ACGIH TLV booklet.

Table A2.2. Exposure Variation Due to Clothing (Values given in º F WBGT)

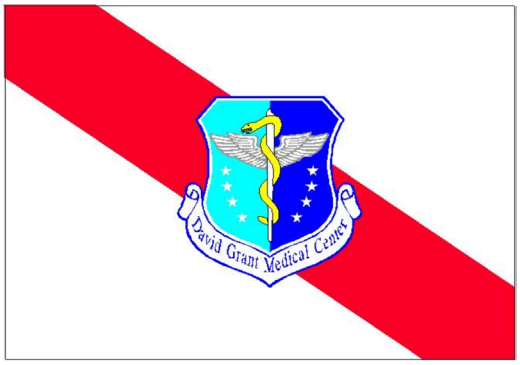
Clothing Type	WBGT (Heat Stress) Index Correction Factor
Cotton Coveralls	4
Heavy Restrictive Clothing (CWDE)	10
2nd Chance Jacket (Security Police)	7

A2.2.1. Exposure limits can vary due to employee clothing. Supervisors will obtain the current Heat Stress Index then determine the correction factor from **Table A2.2.** with respect to the worker's garments . The correction factor will be added to the current Heat Stress Index and the new corrected Heat Stress Index will apply to all employees working with clothing.

A2.2.2. Example: The current WBGT (Heat Stress) Index is 80º F. IAW **Table A2.1.**, workers performing light workloads perform continuous work. However, IAW **Table A2.2.**, personnel working in heavy, restrictive or impermeable clothing would use a 10º F correction factor. The corrected WBGT Index is 90º (80+10 = 90). Thus the worker in heavy restrictive clothing performing light work should be on a 25% work and 75% rest regimen.

Attachment 3

HEAT STRESS SYMBOL



Shaded stripe indicates variable color area

Shaded Area Color	Heat Stress Condition
Green	Green
Yellow	Caution
Red	Warning
Black	Danger